
HDOT TM 6 - 00

Standard Practice for Operation of the California Type Profilograph and Evaluation of Profiles

1. Scope:

1.1 This test method covers the operation of the California Type Profilograph, the procedure used for determining the Profile Index from profilograms of pavements made with the Profilograph, and the procedure used to locate individual high points in excess of specification limits.

2. Operation of the California Type Profilograph

2.1 Apparatus

2.1.1 The California Type Profilograph consists of a frame 7.6 m (25 ft) in length supported upon wheels at either end. The profile is recorded from the vertical movement of a wheel attached to the frame at midpoint and is in reference to the mean elevation of the points of contact with the road surface established by the support wheels (see Figure 1). The profilogram is recorded on a scale of 1:300 (1 in = 25 ft) longitudinally and 1:1 or full scale, vertically. (If a computerized recorder is used, the profile trace must have the same scales.) Motive power may be provided manually or by the use of a propulsion unit powered with an engine attached to the assembly.

2.2 Operation

2.2.1 Clear the intended profilograph path of all loose material and foreign objects.

2.2.2 Move the profilograph at a speed no greater than a 5 km/hr (3 mph) so as to eliminate as much bounce as possible. Too high a speed will result in a profilogram that is difficult to evaluate.

2.3 Calibration

2.3.1 To check the height recording, place a gage block of known thickness between 10 mm (0.5 in) and 40 mm (1.5 in) under the surface of the sensing wheel. The record must indicate the actual height within ± 0.5 mm (± 0.02 in). Verify the height recording before any week of use, whenever the profilograph is reassembled and whenever there is evidence of possible inaccuracy.

2.3.2 To check the distance recording, mark a distance of 30.00 m (100.00 ft) on reasonably even pavement. Move the profilograph forward over the marked distance. The record must indicate 30.0 ± 0.3 m (100 ± 1 ft) between the marked points. Verify the distance recording before any month of use and whenever there is evidence of possible inaccuracy.

3. Determination of the Profile Index

(NOTE: Calculations can be done manually as follows or electronically with all requirements in a computer)

3.1 Apparatus

3.1.1 To determine the Profile Index, use a clear plastic template approximately 50 mm (2 in) wide and 536 mm (21.12 in) long representing a pavement length of 161 m (528 ft) at a scale of 1:300 (1 in = 25 ft). The center of the template is marked with an opaque band 5 mm (0.2 in) wide extending the entire length of 536 mm (21.12 in). On either side of this band are scribed lines 2.5 mm (0.1 in) apart, parallel to the opaque band. These lines serve as a convenient scale to measure deviations or excursions of the graph above or below the blanking band. These are called "scallop".

3.2 Method of Counting

3.2.1 Place the plastic scale over the profile in such a way as to "blank out" as much of the profile as possible. When this is done, scallops above and below the blanking band usually will be approximately balanced. (See Figure 2.)

3.2.2 The profile trace will move from a generally horizontal position when going around super elevated curves making it impossible to blank out the central portion of the trace without shifting the scale. When such conditions occur, the profile should be broken into short sections and the blanking band repositioned on each section while counting, as shown in the upper part of Figure 3.

3.2.3 Starting at the right end of the scale, measure and total the height of all the scallops appearing both above and below the blanking band, measuring each scallop to the nearest 1 mm (0.05 in). Write this total on the profile sheet near the left end of the scale together with a small mark to align the scale when moving to the next section. Short portions of the profile line may be visible outside the blanking band but unless they project 1 mm (0.03 in) or more and extend longitudinally for 0.6 m (2 ft) or more, (2 mm or 0.08 in on the profilogram) they are not included in the count. (See Figure 2 for illustration of these special conditions).

3.2.4 When scallops occurring in the first 161 m (0.1 mi) are totaled, slide the scale to the left, aligning the right end of the scale with the small mark previously made, and proceed with the counting in the same manner. The last section counted may or may not be an even 161 m (0.1 mi). If not, its length should be scaled to determine its length in meters (miles). An example follows:

	Section length, <u>meters (miles)</u>		Counts, 2.5 mm <u>(0.1 in)</u>
	161	(0.10)	5.0
	161	(0.10)	4.0
	161	(0.10)	3.5
	<u>122</u>	<u>(0.076)</u>	<u>2.0</u>
Total	605	(0.376)	14.5

3.2.5 The Profile Index is determined from the counts of profile as follows:

3.2.5.1 Using the figures from the above example:

Length = 605 m (0.376 mi)
 Total Count = 14.5
 Profile Index, PI = 1,609.3 m (1 mi)/length of profiles in meters (miles)
 times total count divided by 10

$$PI = 1609.3 / 605(1/0.376) \times 14.5/10 = 3.9$$

3.2.6 The Profile Index is thus determined for the profile of any line called for in the specifications. Profile Indexes may be averaged for two or more profiles of the same section of road if the profiles are the same length.

3.2.6.1 Example:

Section length, meters (miles)		Counts, 2.5 mm (0.1 in)	
		Left wheel track	Right wheel track
161	(0.10)	5.0	4.5
161	(0.10)	4.0	5.0
161	(0.10)	3.5	3.0
122	(0.076)	2.0	1.5
Total = 605	(0.376)	14.5	14.0
PI (by formula)		3.9	3.7
Average PI = (3.9 + 3.7)/2		= 3.8	

3.2.7 The project specifications shall state which profiles to use when computing the average Profile Index for control of construction operations.

3.3 Limitations of Count in 161 Meters (0.1 Mile) Section

3.3.1 When the specifications limit the amount of roughness in "any 161 m (0.1 mi) section," the scale is moved along the profile and counts made at various locations to find those sections if any, that do not conform to specifications. The limits are then noted on the profile and can be later located on the pavement preparatory to grinding.

3.4 Limits of Counts - Joint

3.4.1 When counting profiles, a day's paving is considered to include the last portion of the previous day's work, which includes the daily joint. The last 5 to 10 m (15 to 30 ft) of a day's paving cannot usually be obtained until the following day. In general, the paving contractor is responsible for the smoothness of joints if he places the concrete pavement on both sides of the joint. On the other hand, the contractor is responsible only for the pavement placed by him if the work abuts a bridge or a pavement placed under another contract. Profilograph readings when approaching such joints should be taken in conformance with current specifications.

3.5 Average Profile Index for the Whole Job

3.5.1 When averaging Profile Indexes to obtain an average for the job, the average for

each day must be "weighted" according to its length. This is most easily done by totaling the counts for the 161 m (0.1 mi) sections of a given line or lines and using the total length of the line in the computation for determining the Profile Index.

4. Determination of Individual High Points in Excess of Specification Limit

The project specifications shall indicate the limit of individual high points. 7.5 millimeters (0.3 inch) high point is shown in the following example.

4.1 Equipment

4.1.1 Use a plastic template having a line 25 mm (1-in) long scribed on one face with a small hole or scribed mark at either end, and a slot 7.5 mm (0.3 in) from and parallel to the scribed line. (See Figure 3.) The 25 mm (1 in) line corresponds to a horizontal distance of 7.5 m (25 ft) on the horizontal scale of the profilogram.

4.2 Locating High Points in Excess of 7.5 mm (0.3 in)

4.2.1 At each prominent peak or high point on the profile trace, place the template so that the small holes or scribe marks at each end of the scribed line intersect the profile trace to form a chord across the base of the peak or indicated bump. The line on the template need not be horizontal. With a sharp pencil, draw a line using the narrow slot in the template as a guide. Any portion of the trace extending above this line will indicate the approximate length and height of the deviation in excess of 7.5 mm (0.3 in).

4.2.2 There may be instances where the distance between easily recognizable low points is less than 7.5 m (25 ft) or 25 mm (1 in) on the trace. In such cases a shorter chord length shall be used in making the scribed line on the template tangent to the trace at the low points. It is the intent, however, of this requirement that the baseline for measuring the height of bumps will be as nearly 7.5 m (25 ft) as possible, but in no case to exceed this value. When the distance between prominent low points is greater than 7.5 m (25 ft) make the ends of the scribed line intersect the profile trace when the template is in a nearly horizontal position. A few examples of the procedure are shown in the lower portion of Figure 3.

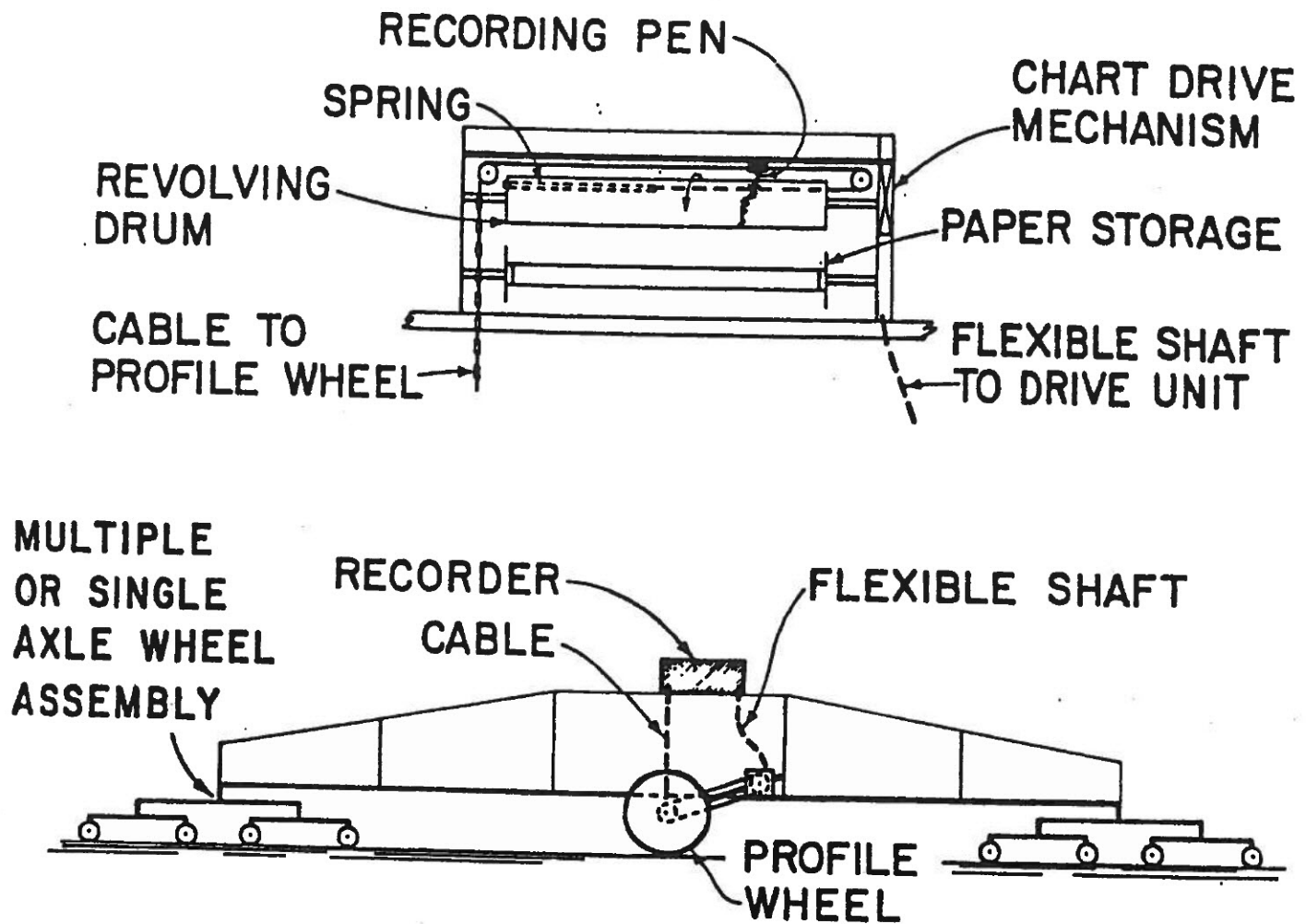
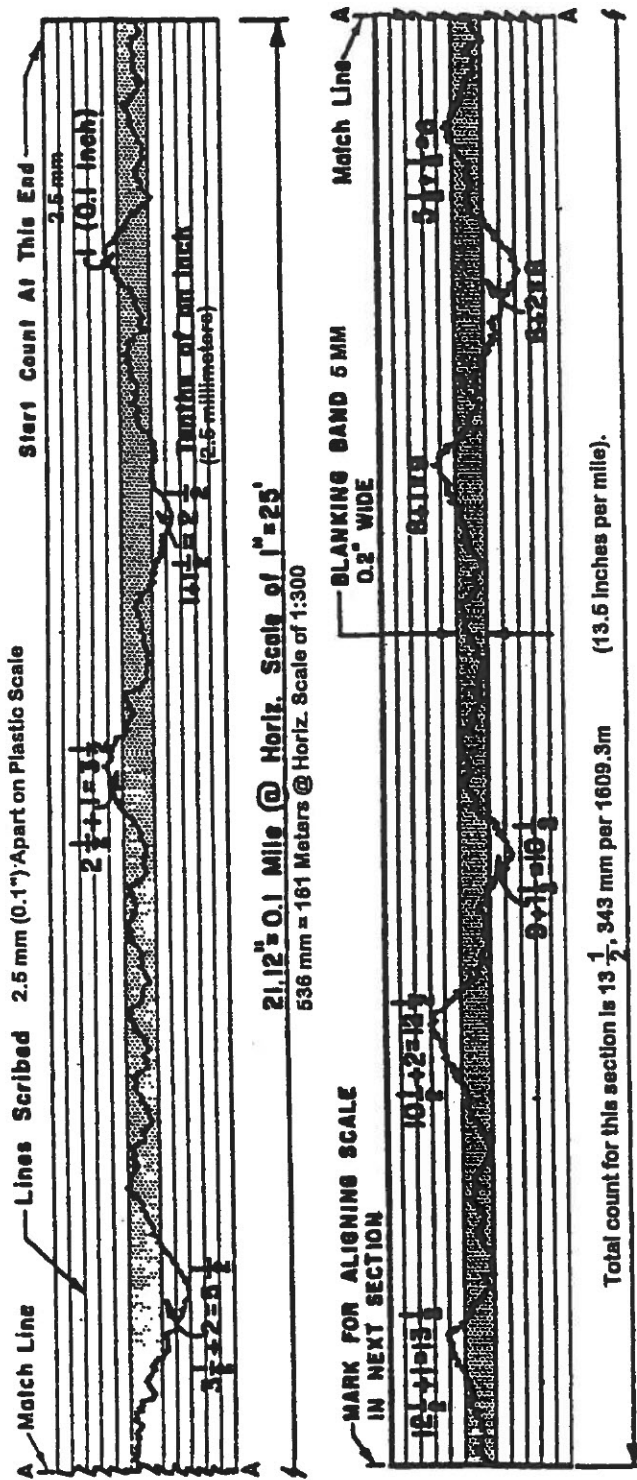


FIGURE 1

EXAMPLE SHOWING METHOD OF DERIVING PROFILE INDEX FROM PROFILOGRAMS



TYPICAL CONDITIONS

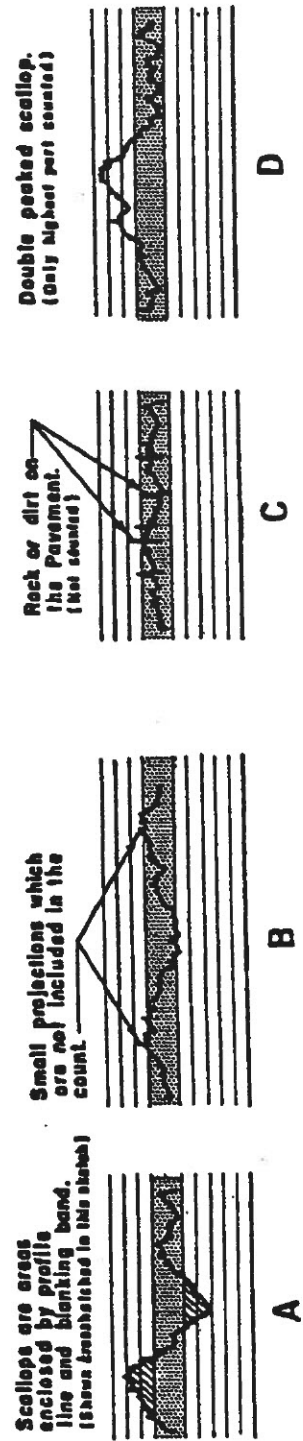
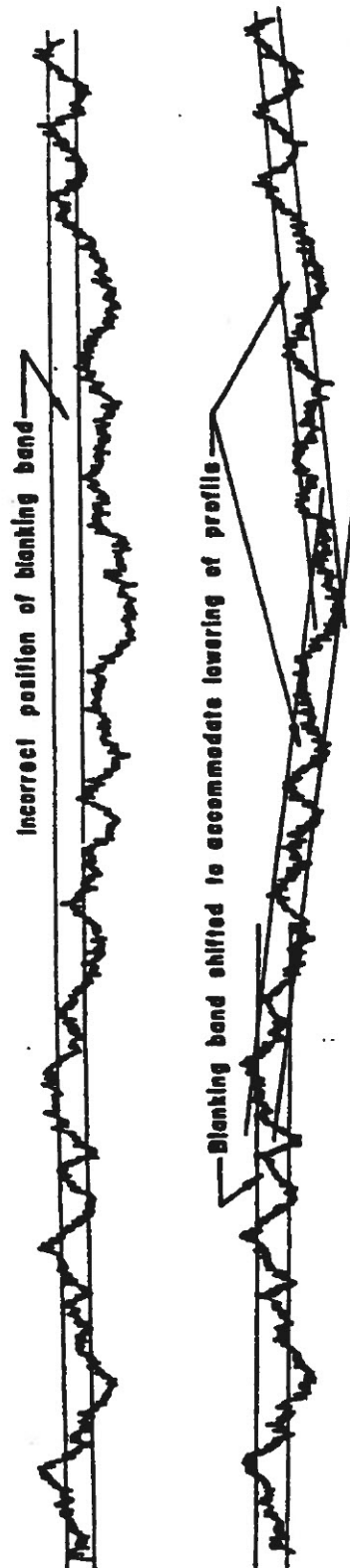


FIGURE 2

METHOD OF COUNTING WHEN POSITION OF PROFILE SHIFTS AS IT MAY WHEN ROUNDING SHORT RADIUS CURVES WITH SUPERELEVATION



METHOD OF PLACING TEMPLATE WHEN LOCATING BUMPS TO BE REDUCED

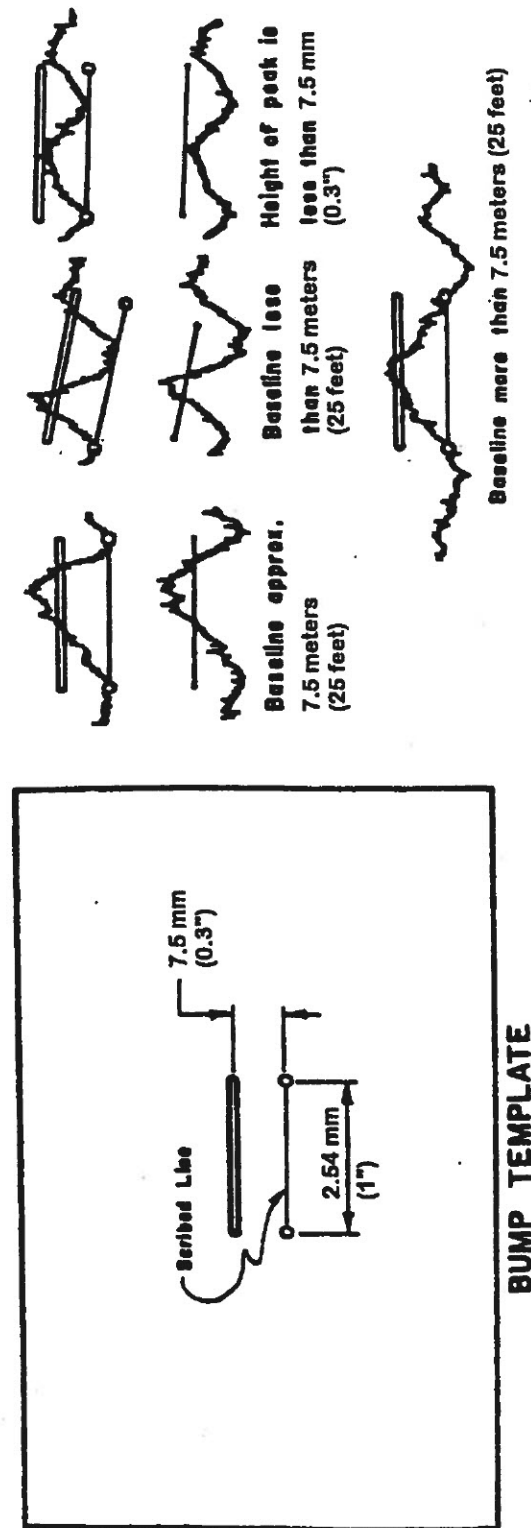


FIGURE 3